Lateral Performance of Thin-Walled Steel Box Piers under Uniaxial and Biaxial Bending

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Usage of steel structures for bridges and viaducts has been the recent trend in the highway construction industry. Steel has been identified as a construction material with long service life, high recoverability, less energy consumption and therefore more sustainable than concrete. Steel structures such as piers (columns) are preferred over their counterpart concrete piers due to their easy and fast construction and minimal disruption to the construction site. Thin-walled steel piers used in these constructions are subjected to various static as well as dynamic loads such as traffic loads, dead loads and seismic loads depending on the region. When it comes to earthquakes, it is important to analyse the piers laterally in both directions. These piers are vulnerable to local buckling due to their low width to thickness ratios and high slenderness ratios. Therefore, they are manufactured with internal stiffener arrangements to provide more resistance towards buckling failures. The focus of this study is to examine the effects of uniaxial and biaxial bending towards the lateral performance of thin-walled steel box piers numerically. Six specimens were created with different width to thickness ratios, slenderness ratios and stiffeners, uniaxial and biaxial cyclic loads were applied on top of the piers and resultant envelope curves were obtained. Results revealed that the models are more vulnerable to overall bucking under biaxial loading conditions. So, this study emphasizes the importance of analysing thin-walled piers under bidirectional loading pattern over the unidirectional loading pattern for structural designs.

Keywords: Box piers, Biaxial bending, Cyclic loads, Finite-element modeling, Steel structures